

# On Phyletic Closeness Between South American and New Caledonian Spilopyrines (Chrysomelidae, Eumolpinae, Tribe Spilopyrini)<sup>1</sup>

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**Abstract.** Among members of the eumolpine tribe Spilopyrini (Reid 1995), the South American genera *Hornius* and *Stenomela* and the New Caledonian *Bohumiljanina* are especially similar, while the Australian and the New Guinean forms seem to stand a little apart. In this communication, by tracing taxonomic history of spilopyrines, and by taking into account their food plants, palaeogeological history of the Southern Hemisphere, anatomical features of spilopyrines, and their developmental stages, a possible phyletic closeness between the South American and the New Caledonian genera has been inferred.

**Key words.** Taxonomy, ecology, zoogeography

## 1. INTRODUCTION

REID (2000) separated some members of the chrysomelid subfamily Eumolpinae, and put them in a new subfamily, Spilopyrinae. Earlier these genera had been regarded by REID (1995) as a tribe under Eumolpinae, the Tribe Spilopyrini. These primitive Eumolpinae are being referred to in this communication as spilopyrines, following VERMA & JOLIVET (2004). The spilopyrin genera include: *Spilopyra* Baly, 1860 (Australia and New Guinea), *Macrolema* Baly, 1861 (Australia and New Guinea), *Richmondia* Jacoby, 1898 (Australia), *Cheiloxena* Baly, 1860 (Australia), *Stenomela* Erichson, 1847 (Chile), *Hornius* Fairmaire, 1848 (Chile and Argentina), and *Bohumiljanina* Monrós, 1958 (New Caledonia). As pointed out by VERMA & JOLIVET (2004), the Chilean and the New Caledonian spilopyrines are especially similar. This communication aims to emphasize a possible phyletic closeness between the South American and the New Caledonian spilopyrines. In this context the following are specifically notable.

## 2. TAXONOMIC HISTORY

JOLIVET (1954), describing the wing venation in the New Caledonian spilopyrin, referred to it as *Stenomela caledonica*. MONRÓS (1958) created a new generic name for this spilopyrin, *Bohumiljanina*. SEENO & WILCOX (1982), following MONRÓS (1958), placed *Stenomela* and the New Caledonian *Bohumiljanina* together under the Tribe Stenomelini, a tribe under Eumolpinae. The Tribe Hornibiini, with a single genus *Hornius*, has been placed close to the Tribe Stenomelini.

These bits of taxonomic history clearly support the notion of phyletic closeness between the S. American and the New Caledonian forms.

## 3. FOOD PLANTS

*Hornius* of Chile, as larva and adult, is a specialised feeder on leaves and bark of *Nothofagus* trees (Fagaceae) (JEREZ 1996). *Stenomela* of the same region, on the other hand feeds on different species of Myrtaceae (*Blepharocalyx crukshanksii* Niedenzu and *Luma* spp.). *Bohumiljanina caledonica* in the distant New Caledonia, also feeds on Myrtaceae (*Sizygium* spp.). This is a point of similarity between *Stenomela* and *Bohumiljanina*. But in spilopyrines, *Cheiloxena* in Australia also feeds on Myrtaceae (*Eucalyptus* spp.) and *Spilopyra* on Sapindaceae (*Cupaniopsis* and *Guioa*). Host plants of *Macrolema* and *Richmondia* are not on record (JOLIVET et al. 2003).

## 4. PALAEOGEOLOGICAL HISTORY

In the context of distribution of spilopyrines, the Gondwana Hypothesis has been invoked by JEREZ (1996) and REID (2000). HOLLOWAY (1979) and VERMA & JOLIVET (2004) have pointed out that in the late Cretaceous (75 mya) continental shelves of S. America and of the Australian Plate were still connected with those of the Antarctica, while Africa and India, that also resulted from the break, had moved away northward considerably removed from Gondwanaland.

In a recent paper SANMARTIN & RONQUIST (2004) gave a detailed and interesting account of Gondwanian history, supported by explicit maps of the southern hemisphere in different geological periods. The following parts of the history, as mentioned in that paper

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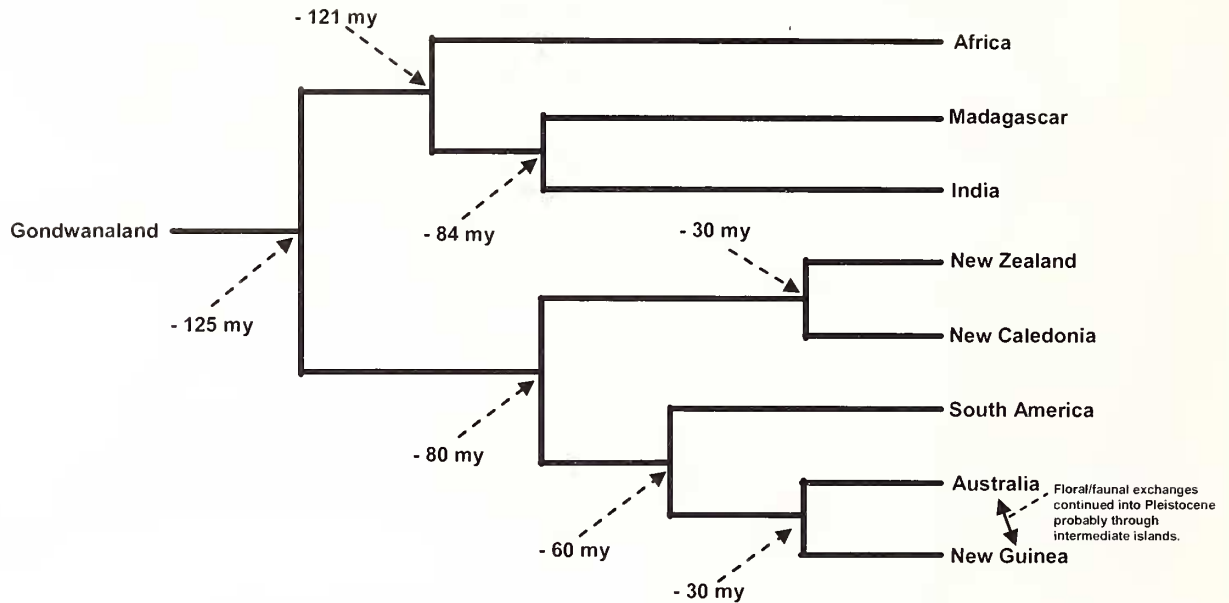


Fig. 1. Cladograms showing sequence of separation of land masses in the Southern Hemisphere (based on data in SANMARTIN & RONQUIST 2004, and in a summary of her studies provided by I. Sanmartin, Uppsala, pers. comm. 2004).

and in a summary of their work, provided by Isabel Sanmartin (Uppsala, pers. comm. 2004), are of special interest in the present context.

- (i) "Consistent with other studies, the animal data are congruent with the geological sequence of Gondwana breakup.....Trans-Antarctic dispersal (Australia  $\leftrightarrow$  southern South America) is also significantly more frequent than any other dispersal event in animals, which may be explained by the long period of geological contact between Australia and South America via Antarctica." (SANMARTIN & RONQUIST 2004).
- (ii) In Palaeocene (60 mya) New Zealand + New Caledonia separated from Australia.
- (iii) In mid to late Tertiary (mid Tertiary 40 to 30 mya) New Caledonia separated from New Zealand.
- (iv) During the period 60 to 30 mya Australia and South America remained in contact across Antarctica (Fig. 5), and this continued up to Eocene-early Miocene. At this time the Antarctica had a warm temperate climate, and had a rich flora, dominated by *Nothofagus*, as evidenced by fossils of this plant found in coastal parts of the Antarctica. Ready dispersal of *Nothofagus* to Australia and South America is probable. I. Sanmartin (Uppsala, pers. comm. 2004) points out, "This (= a warm temperate climate in the Antarctica) presumably established a significant dispersal route for the exchange of southern temperate biota between South America and Australia"

- (v) Opening of the Drake passage between Antarctica and South America at the boundary between Eocene and Oligocene (30 to 28 mya led to the onset of the Circum-Antarctic Current, and this resulted in cooling of the Antarctica.

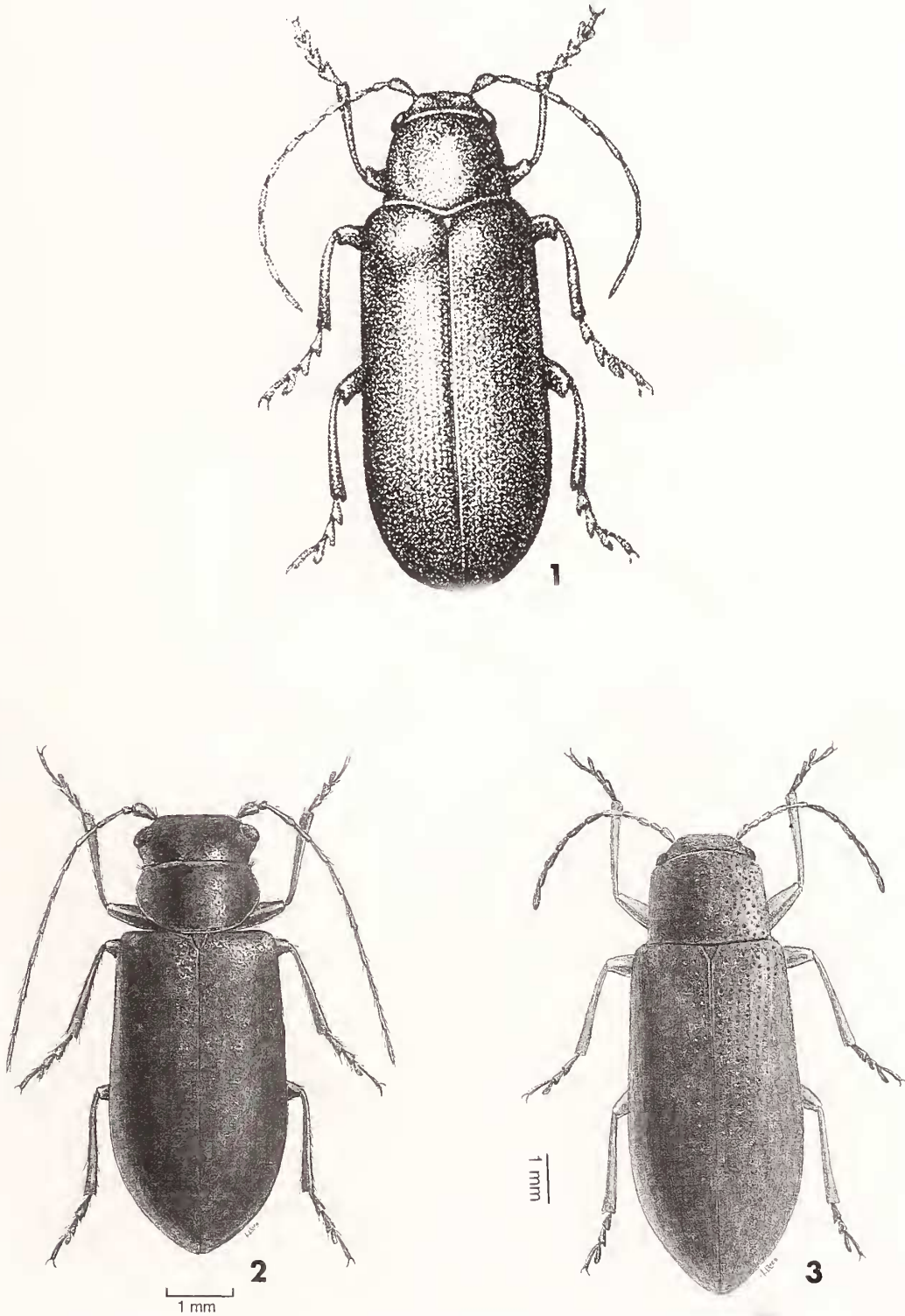
JEREZ (1996) has pointed out that *Nothofagus* arose in the Australian part of Gondwana, and from there it dispersed to New Zealand and S. America.

As mentioned above, *Hornius* is a specialized feeder on *Nothofagus*. It appears that primitive spilopyrines dispersed to Australia, New Caledonia and S. America, along with temperate flora, like *Nothofagus*, and subsequently, due to cooling and development of subantarctic conditions in the southern part of S. America, and due to separation of New Caledonia as an island from the Australian Plate, the primitive spilopyrines in these parts became shielded from competition with more modern forms, and have survived as *Hornius* and *Stenomela* in southern S. America, and as *Bohumiljanina* in New Caledonia. One may ask: New Guinea is also an island, and it shares *Spilopyra* and *Macrolema* with Australia, then how island isolation of New Caledonia could help the survival of *Bohumiljanina* as a primitive spilopyrin? One answer to this question: New Zealand + New Caledonia separated from Australia in Palaeocene (60 mya), whereas floral and faunal exchanges between Australia and New Guinea could continue even into the Pleistocene (I. Sanmartin, Uppsala, pers. comm., 2004) (Fig. 5).

**5. ANATOMICAL FEATURES**

New Caledonian and S. American spilopyrines have an elongated and cerambycid like body shape (Fig. 2). The Australo-Papuan genera in contrast have a more compact

and robust body form like typical Eumolpinae. All the three S. American-New Caledonian genera are light green in colour on the host plant. On the other hand the Australian genera show bright and diverse metallic colours.



**Fig. 2.** New Caledonian and South American spilopyrines. (i) *Bohumiljanina* (from JOLIVET et al. 2003); (ii) *Hornius* (from JEREZ 1996); (iii) *Stenomela* (from JEREZ 1996).



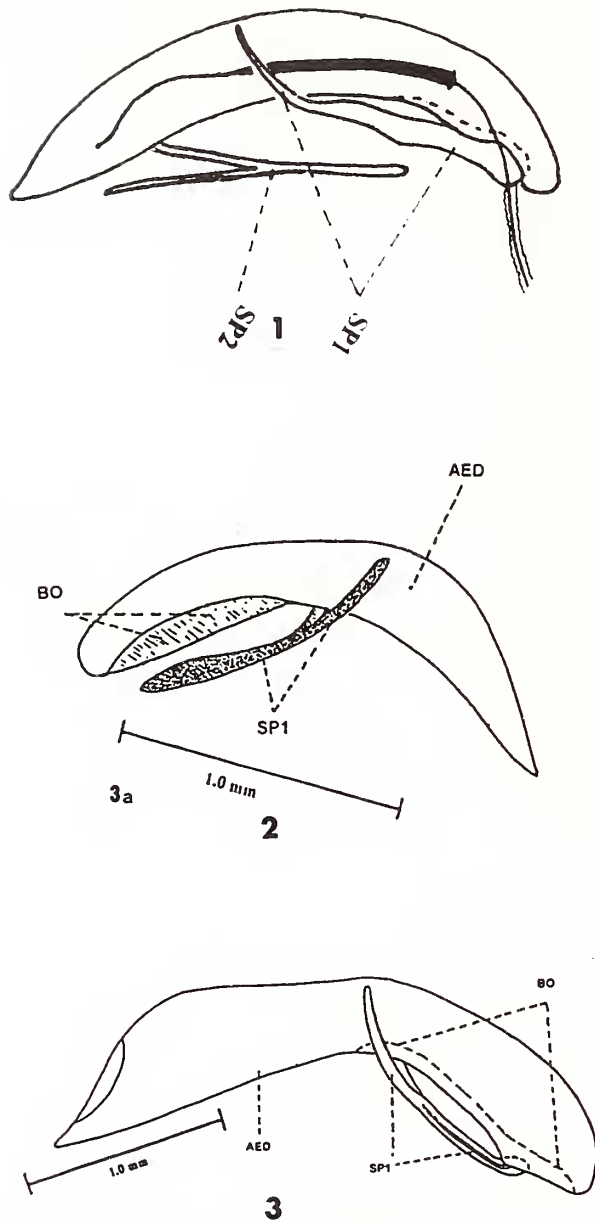


Fig. 3. Aedeagi, lateral view. (i) of *Bohumiljanina*; (ii) of *Hornius*; (iii) of *Stenomela* (from VERMA & JOLIVET 2004).

The aedeagal structure in spilopyrines in general is primitive, as discussed by VERMA & JOLIVET (2004). But in *Hornius*, *Stenomela* and *Bohumiljanina* it is even more primitive; the primitive features of their aedeagi include:

- (i) Poor differentiation of the basal hood and the aedeagus proper (Fig. 3).
- (ii) Only moderate ventral curvature of the aedeagus, spread throughout the length of the organ, and not confined to the basal part of the aedeagus proper. In *Stenomela*, however the curvature is more marked in the basal part of the aedeagus proper.

- (iii) The ventrally directed basal orifice of the aedeagus is relatively restricted anteroposteriorly.

In contrast: (i) In *Spilopyra*, *Macrolema*, *Cheiloxena* and *Richmondia* the differentiation of the basal hood and the aedeagus proper is somewhat better marked than in the S. American and New Caledonian forms; (ii) In *Richmondia*, *Cheiloxena* and to some extent in *Spilopyra* the ventral curvature of the aedeagal tube is more marked than in S. American and New Caledonian spilopyrines, and in *Richmondia* and *Cheiloxena* this curvature is almost as strong as in higher Eumolpinae; and (iii) the anteroposterior extent of the basal orifice is large, specially in *Macrolema*, *Cheiloxena* and *Richmondia* (For differences between typical eumolpine and spilopyrin aedeagi see VERMA & JOLIVET 2004).

Thus the aedeagal structure in *Hornius*, *Stenomela* and *Bohumiljanina* is more primitive than in the remaining spilopyrines, and almost of the chrysomeline type (For features of the chrysomeline type of aedeagus see VERMA 1996).

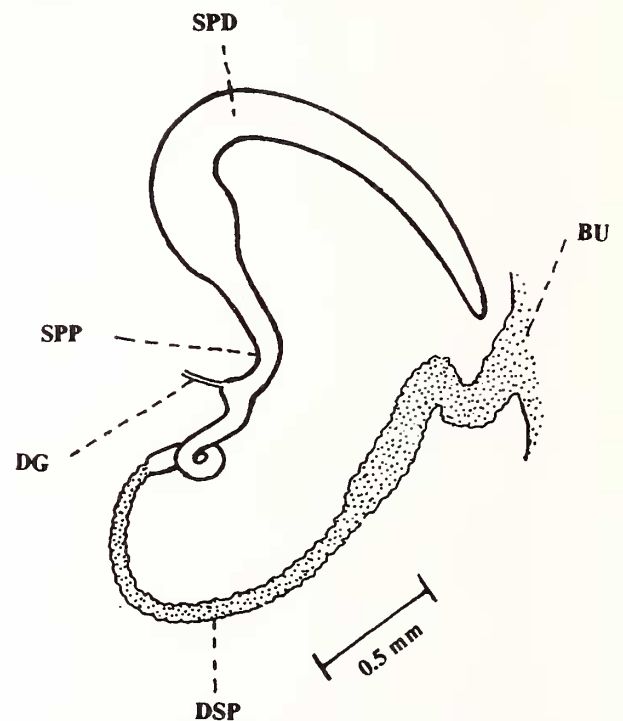
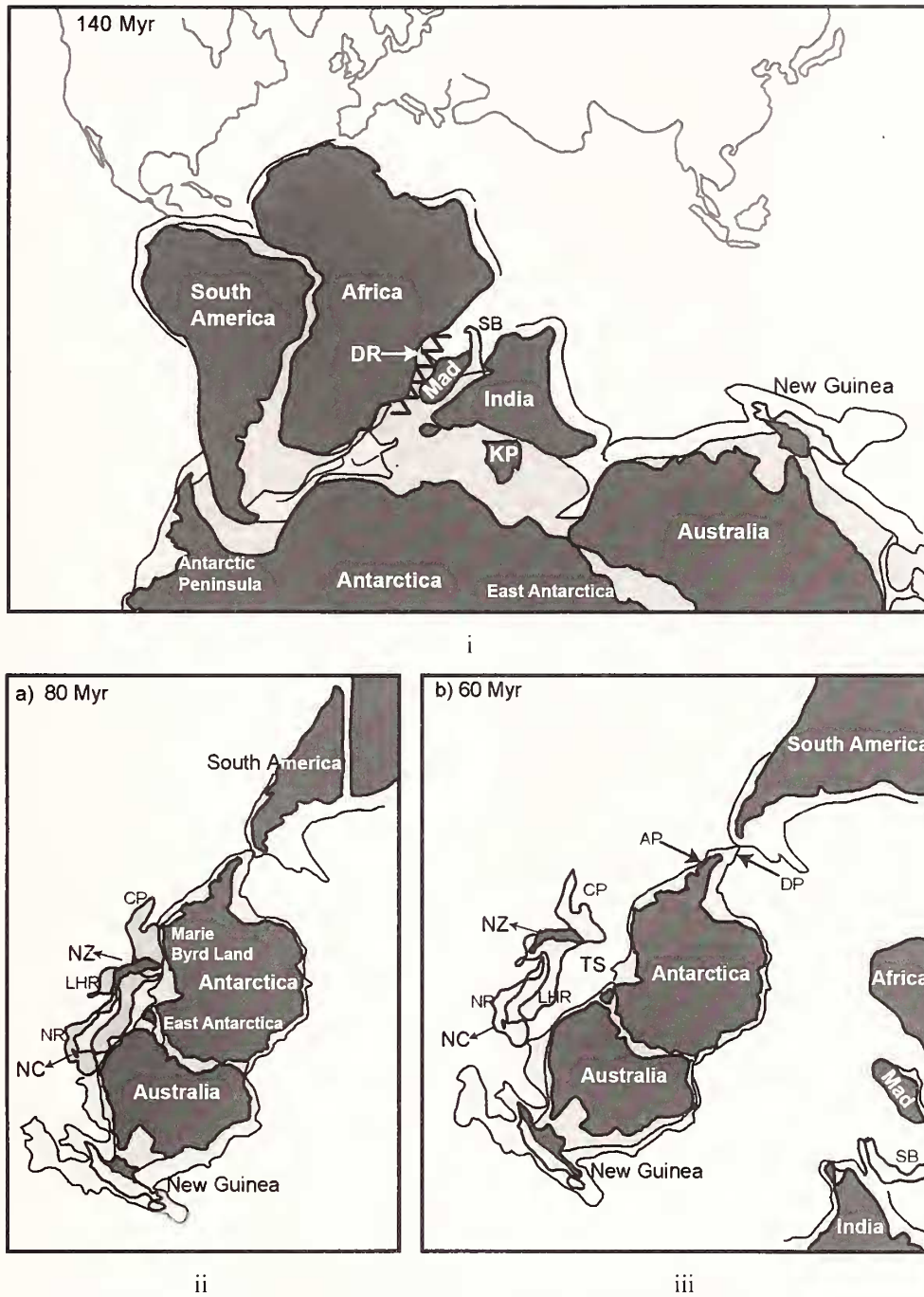


Fig. 4. Spermathecal complex of *Bohumiljanina* (from VERMA & JOLIVET 2004).

Spermatheca in all spilopyrines shows a characteristic eumolpine feature, namely the proximal part of the spermathecal capsule is differentiated into a swollen or bulbous section, which receives the duct of the spermathecal gland and from which the spermathecal duct starts. In *Bohumiljanina* this proximal part is somewhat elongated and presents some irregular coiling (Fig. 4). Such a coiling is seen also in the spermatheca of



**Fig. 5.** Southern hemisphere. (i) Gondwana (-140 my). End of Jurassic; (ii) Polar view of the Southern hemisphere (-80 my). Mid-Cretaceous; (iii) Polar view of the Southern hemisphere (-60 my). Early Eocene. The Drake Passage is just forming. New Zealand, New Caledonia, Norfolk ridge and Lord Howe ridge are also figured (from Isabel Sanmartin summary (2002), pers. comm. 2004, with permission).



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Fig. 6. *Bohumiljanian caledonica* (Jolivet). (1) starting to fly; (2) on a *Syzygium cumini* L. ( Myrtaceae) leaf, in New Caledonia

Megascelinae (SUZUKI 1988). Megascelinae are essentially Central and South American in distribution, and are closely related to Eumolpinae (JOLIVET 1957-1959; REID 1995; COX 1998). Should this situation be regarded as covered by what has been described by MAYR & ASHLOCK (1991) in the following part of their text? "A serious problem is posed by propensity of genotypes to produce a certain phenotype, such as stalked eyes in certain acalyprate dipterans, which is manifested in only some of the possessors of a genotype. Parallelism in this case may be defined as homologous similarity, since the common ancestor evidently had the genetic propensity even if it was not expressed phenotypically." In this context it would be relevant to point out that

*Megascelis* does not have a mediocubital patch in the hind wing like spilopyrines. *Richmondia*, however has a dark spot in this position, and not a well defined mediocubital patch (VERMA & JOLIVET 2004).

## 6. DEVELOPMENTAL STAGES

Eggs of *Hornius* are laid under an oothecal cover, made of excrement material, and a single cover includes 7-8 eggs (JEREZ & CERDA 1988). In *Stenomela*, eggs are also provided with excretory matter cover, each cover protecting two eggs. In *Bohumiljanian* the ootheca is made up of excretory material mixed with vegetal fibres and a glandular secretion, and there are four eggs per ootheca (JOLIVET et al. 2003). Perhaps it will not be out place to mention that in *Megascelis* there is also a membranous protective cover for a batch of about 10 eggs (COX 1988). In remaining spilopyrines laid eggs have not yet been observed and reported.

The neonate larva of *Bohumiljanian* bores onto the stem of the host plant, but later instars are exposed feeders on leaf lamina (JOLIVET et al. 2003). There is a similar habit with the first instar larvae of *Hornius* and *Stenomela*; they pierce into leaf buds and leaf lamina, but later instars are well exposed, feeding on leaves. Larval habits have not been recorded so far for the Australian spilopyrines.

Pupae of *Hornius* are formed in soil in a specially constructed cell (JEREZ 1996). Pupae of *Stenomela* and *Bohumiljanian* have not been observed yet, but they too are believed to be formed in soil (JEREZ 1995; JOLIVET et al. 2003).

## 7. CONCLUDING REMARKS

Phyletic closeness between spilopyrines of New Caledonia and S. America has been hypothesized on the basis of the above discussion. This hypothesis will hopefully gain additional support through further studies on the biology of the Australian spilopyrines, and through DNA analysis studies.

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## REFERENCES

- COX, M. L. 1998. The first instar larva of *Megascelis puella* Lacordaire (Coleoptera, Chrysomelidae, Megascelinae) and its value in the placement of the Megascelinae. *Journal of Natural History* **32**: 387-403.
- HOLLOWAY, J. D. 1979. A survey of the Lepidoptera, biogeography and ecology of New Caledonia. Dr. W. Junk Publishers, The Hague. 588 pages.
- JEREZ, V. 1995. *Stenomela pallida* Erichson, 1847. Redescription, ontogeny and affinities with genus *Hornius* (Chrysomelidae, Eumolpinae). *Gayana Zoologia* **59**: 1-12.
- JEREZ, V. 1996. Biology and phylogenetic remarks of the subantarctic genera *Hornius*, *Stenomela* and *Dictyneis* (Chrysomelidae, Eumolpinae). Pp. 239-258 in: JOLIVET, P. H. A. & COX, M. L. (eds.) *Chrysomelidae Biology*, vol. 3, S. P. B. Academic Publishing, Amsterdam.
- JEREZ, V. & CERDA, L. 1988. Antecedentes morfológicos y biológicos de *Hornius grandis* (Phil. & Phil. 1864) (Chrysomelidae – Eumolpinae). *Bosque* **9**(2): 83-86.
- JOLIVET, P. 1954 (1957-1959). Recherches sur l'aile des Chrysomeloidea (Coleoptera). D.Sc.Thesis (Paris University) and *Memoires de l'Institut Royal des Sciences Naturelles Belgique* **51**: 1-180 and **58**: 1-152.
- JOLIVET, P., VERMA, K. K. & MILLE, C. 2003. Biology and taxonomy of *Bohumiljanica caledonica* (Jolivet) (Coleoptera, Chrysomelidae). *Nouvelle Revue d'Entomologie (N. S.)* **20**(1): 3-22.
- MAYR, E. & ASHLOCK, P. D. 1991. *Principles of Systematic Zoology* (Second Edn.). 475 pp., McGraw-Hill Inc., New York.
- MONROS, F. 1958. Consideraciones sobre la fauna del sur de Chile y revision de la Tribu Stenomelini. *Acta Zoologica Lilloana* **15**: 143-153.
- REID, C. A. M. 1995. A cladistic analysis of subfamilial relationships in the Chrysomelidae sensu lato (Chrysomeloidea). Pp.559-631 in: PAKALUK, J. & SLIPINSKI, S. A. (eds.) *Biology, Phylogeny, and Classification of Coleoptera- Papers celebrating the 80<sup>th</sup> Birthday of Roy A. Crowson*. Warszawa Muzeum Instytut Zoologii PAN.
- REID, C. A. M. 2000. Spilopyrinae Chapuis: a new subfamily in the Chrysomelidae and its systematic placement (Coleoptera). *Invertebrate Taxonomy* **14**: 837-862.
- SANMARTIN, I. & RONQUIST, F. 2004. Southern hemisphere biogeography inferred by event-based models: plant versus animal patterns. *Systematic Biology* **53**(2): 216-243.
- SEENO, T. N. & WILCOX, J. A. 1982. *The Leaf Beetle Genera (Coleoptera, Chrysomelidae)*. Entomography Publications, Sacramento, CA, USA, pp. 1-221.
- SUZUKI, K. 1988. Comparative morphology of the internal reproductive system of the Chrysomelidae (Col.). Pp. 317-355 in: JOLIVET, P., PETITPIERRE, E. & HSIAO, T. H. (eds.) *Biology of Chrysomelidae*. Kluwer Academic Publishers, Dordrecht.
- VERMA, K. K. 1996. Inter-subfamily relations among Chrysomelidae as suggested by organization of the male genital system. Pp. 317-351 in: JOLIVET, P. H. A. & COX, M. L. (eds.) *Chrysomelidae Biology*, vol. 3, S. P. B. Academic Publishing, Amsterdam.
- VERMA, K. K. & JOLIVET, P. 2002. Comments on Spilopyrinae (Col. Chrysomelidae). *Nouvelle Revue d'Entomologie (N. S.)* **19**(2):99-110.
- VERMA, K. K. & JOLIVET, P. 2004. The primitive Eumolpinae and the Gondwana Hypothesis. Pp. 395-406 in: JOLIVET, P., SANTIAGO-BLAY, J. A. & SCHMITT, M. (eds.) *New Developments in the Biology of Chrysomelidae*. S. P. B. Academic Publishing bv, the Hague.

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